(12) **United States Patent**
Urmson et al.

(10) **Patent No.:** **US 8,954,252 B1**
(45) **Date of Patent:** **Feb. 10, 2015**

(54) **PEDESTRIAN NOTIFICATIONS**

(71) Applicant: **Google Inc.**, Mountain View, CA (US)

(72) Inventors: **Christopher Paul Urmson**, Mountain View, CA (US); **Ian James Mahon**, Berkeley, CA (US); **Dmitri A. Dolgov**, Mountain View, CA (US); **Jiajun Zhu**, Sunnyvale, CA (US)

(73) Assignee: **Google Inc.**, Mountain View, CA (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/095,107**

(22) Filed: **Dec. 3, 2013**

### Related U.S. Application Data

(63) Continuation of application No. 13/628,290, filed on Sep. 27, 2012.

(51) **Int. Cl.**
*G08G 1/16* (2006.01)

(52) **U.S. Cl.**
CPC .................................... *G08G 1/166* (2013.01)
USPC ................. **701/70**; 701/25; 701/36; 701/301; 340/435; 340/436; 340/901; 340/903; 340/933; 180/167

(58) **Field of Classification Search**
USPC ............. 701/24, 36, 45, 70, 96, 301, 302, 25; 340/435, 436, 901, 903, 937, 943; 348/148; 382/103, 104, 107; 180/168, 180/169
See application file for complete search history.

(56) **References Cited**

#### U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 2,190,123 | A * | 2/1940 | Pace .............................. | 362/503 |
| 5,485,892 | A * | 1/1996 | Fujita ........................... | 180/167 |
| 5,642,094 | A * | 6/1997 | Marcella ....................... | 340/479 |
| 6,072,391 | A * | 6/2000 | Suzuki et al. ................. | 340/468 |
| 7,095,318 | B1 * | 8/2006 | Bekhor ......................... | 340/485 |
| 7,194,347 | B2 * | 3/2007 | Harumoto et al. ............. | 701/45 |
| 7,209,822 | B2 * | 4/2007 | Linden ........................... | 701/96 |
| 7,671,725 | B2 * | 3/2010 | Tsuji et al. .................... | 340/435 |
| 7,696,863 | B2 * | 4/2010 | Lucas et al. ................... | 340/435 |

(Continued)

#### FOREIGN PATENT DOCUMENTS

JP        2008-120162  A        5/2008

#### OTHER PUBLICATIONS

Massimo Bertozzi, Alberto Broggi, Massimo Cellario, Alessandra Fascioli, Paolo Lombardi, and Marco Porta, Artificial Vision in Road Vehicles, Proceedings of the IEEE, vol. 90, No. 7, Jul. 2002, pp. 1258-1271.

(Continued)

*Primary Examiner* — Thomas G Black
*Assistant Examiner* — Sara Nelson
(74) *Attorney, Agent, or Firm* — Lerner, David, Littenberg, Krumholz & Mentlik, LLP

(57) **ABSTRACT**

Aspects of the disclosure relate generally to notifying a pedestrian of the intent of a self-driving vehicle. For example, the vehicle may include sensors which detect an object such as a pedestrian attempting or about to cross the roadway in front of the vehicle. The vehicle's computer may then determine the correct way to respond to the pedestrian. For example, the computer may determine that the vehicle should stop or slow down, yield, or stop if it is safe to do so. The vehicle may then provide a notification to the pedestrian of what the vehicle is going to or is currently doing. For example, the vehicle may include a physical signaling device, an electronic sign or lights, a speaker for providing audible notifications, etc.

**18 Claims, 12 Drawing Sheets**



100